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Polygenic Prediction of Cognitive Abilities Between and Within Family Members

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ABSTRACT:

Disentangling how genes and environments combine to influence outcomes is fundamental to the field of behavioral genetics. Genome-wide association studies (GWAS) of unrelated individuals quantify allelic associations that may reflect both direct genetic effects as well as indirect genetic effects (“genetic nurture” from rearing environments). Recent work separating effects of polygenic scores into within- and between-family effects has shown that cognitive traits may be especially likely to be impacted by indirect genetic effects in addition to direct effects. Family data are useful for studying these effects because within-family effects control for shared environmental influences, whereas between-family genetic effects may be inflated by assortative mating or gene-environment correlations. Indeed, comparisons of within- vs. between-family effects for polygenic scores suggest indirect genetic effects for cognition-related traits such as educational attainment and intelligence, in contrast to more biological traits like height that show predominately direct genetic effects. However, the range of cognitive phenotypes examined so far has been limited, focusing primarily on intelligence and educational attainment. Here we investigate whether different cognitive constructs, particularly executive functioning and speed, show patterns consistent with indirect genetic effects that are similar to the patterns obtained with intelligence and educational attainment. Using GWAS summary statistics for the UK Biobank sample, we calculated polygenic scores for common executive functioning, intelligence, speed, and educational attainment in a sample of ~300 dizygotic twin pairs from two Colorado twin studies. Then we used mixed models to parse their effects on cognitive outcomes into between and within-family effects.

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